The effectiveness of an aviation system is commonly measured in terms of its ability to efficiently process and serve aviation demand. A key element in measuring this effectiveness is determining the system's capacity to accommodate current as well as projected operational demand in terms of airfield and landside facilities. It is important to note that both airfield and landside capacity should be addressed in tandem. For example, constructing an additional runway may resolve an airfield operational capacity issue, however, if additional landside facilities cannot be constructed to accommodate the demand generated by the additional operating capacity, the true benefit of the runway will not be achieved. This is especially true as it relates to airspace capacity and its relationship to airfield operating capacity.

For this analysis, operational capacity and facility needs are addressed for each of the MAG system airports to a system planning level of detail for this analysis. To evaluate facility needs for the airports, an understanding of the airports' roles is needed. Therefore, a discussion of classification systems used to identify an airport's role and its related facility needs is also provided in this working paper.

The Demand Capacity Analysis is documented in the following sections:

- Airport Classifications
  - National Plan of Integrated Airport Systems (NPIAS)
  - Airport Reference Code
  - Primary and Secondary Airport Classifications
  - ADOT Airport Categories

- Airside Capacity
  - Annual Service Volume
  - Aircraft Delays
  - Hourly Runway Capacity

- Facility Requirements
  - Runway Length Requirements
  - Runway Width Requirements
  - Runway Strength Requirements
  - Runway Design Standards
  - Taxiway Requirements
  - Navigational Aid (NAVAID) Requirements
  - Aircraft Storage Requirements
  - Commercial Space Requirements

- Airspace Capacity
  - Northwest 2000 Plan
  - Satellite Airport Impact
  - Luke Air Force Base
  - Airspace Capacity by Time of Day
  - Potential Airspace Constraints on Airport Alternatives

AIRPORT CLASSIFICATIONS

Depending on an airport's role in the system in which it operates, various facilities are needed to serve the type of demand that is expected to operate at the airport. The Federal Aviation Administration (FAA) and the Arizona Department of Transportation (ADOT) use four basic aviation facility classifications to describe an airport's role in the system. The first is a classification system utilized in the FAA's National Plan of Integrated Airport Systems (NPIAS). The second is a coding system used by the FAA to relate airport design criteria to the operational and physical characteristics of the airplanes operating at an airport. The third is a hierarchical classification used by the ADOT Aeronautics Division that segregates the state's airports into Primary and Secondary systems. The final classification, which is also used by ADOT, is a system that categorizes airports by their basic function.

National Plan of Integrated Airport Systems (NPIAS)

The NPIAS is a national airport system plan developed by the FAA to indicate aviation facilities of national significance. NPIAS airports are eligible to apply for federal grants for airport planning and various capital improvements. The NPIAS defines an airport's status by its service level. The service level of an airport reflects the type of public service the airport provides to the community. The service level also reflects the funding categories established by Congress to assist in airport development. These categories are as follows:

- Primary Service (PR): Primary Service airports are public-use airports that both receive scheduled airline passenger service and enplane at least 10,000 passengers per year.

- Commercial Service (CM): Commercial Service airports are public-use airports that both receive scheduled airline passenger service and annually enplane at least 2,500 passengers.

- General Aviation (GA): General Aviation airports are either publicly or privately owned public-use airports that serve general aviation needs.

- Reliever (RL): Reliever airports are general aviation airports designated by the FAA as having the function of relieving congestion at a commercial service airport and providing general aviation access to the overall community. In order to be considered for designation as a reliever, the airport must have a current activity level of at least 100 based aircraft or 25,000 annual itinerant operations. The relieved airport must serve a metropolitan area with a population of at least 250,000 or at least have 250,000 annual enplaned passengers.

Airport Reference Code

The Airport Reference Code (ARC) is a coding system developed by the FAA that is used to relate airport design criteria to the operational and physical characteristics of the airplanes intended to operate at an airport. The first component of the ARC, which is depicted by a letter, is the aircraft approach category. This component is dependent upon the aircraft approach speed. The different aircraft approach speed categories are as follows:

- Category A: Speed less than 91 knots
- Category B: Speed greater than or equal to 91 knots, but less than 121 knots
- Category C: Speed greater than or equal to 121 knots, but less than 141 knots
- Category D: Speed greater than or equal to 141 knots, but less than 166 knots
- Category E: Speed greater than or equal to 166 knots

The second component of the ARC, which is depicted by a Roman numeral, is the airplane design group. This component is dependent upon the wingspan of an airplane. The airplane design group categories are as follows:

- Design Group I: Wingspan less than 49 feet
- Design Group II: Wingspan greater than or equal to 49 feet, but less than 79 feet
- Design Group III: Wingspan greater than or equal to 79 feet, but less than 118 feet
- Design Group IV: Wingspan greater than or equal to 118 feet, but less than 171 feet
- Design Group V: Wingspan greater than or equal to 171 feet, but less than 214 feet
- Design Group VI: Wingspan greater than or equal to 214 feet, but less than 262 feet

Generally, aircraft approach speed applies to runways and runway-related facilities. Airplane wingspan primarily relates to separation criteria involving taxiways and taxilanes.

Airports expected to accommodate single-engine airplanes normally fall into Airport Reference Code B-I. Airports that serve larger general aviation and commuter-type planes are usually Airport Reference Code B-II or C-II. Small to medium-sized airports serving air carriers are usually Airport Reference Code C-III. Larger air carrier airports are usually at least Airport Reference Code D-IV.

ADOT Primary and Secondary Airport Classifications

The ADOT Aeronautics Division divides Arizona's aviation system into two subsystems: a Primary and a Secondary system. The size and usage of the airports are the primary criteria used to determine to which subsystem each airport belongs. Airports in the primary system must be open to the public and meet at least one of the following criteria:

- The airport is classified as a Commercial Service, Reliever, and/or General Aviation airport.
- The airport has 10 or more based aircraft.
- The airport has 2,000 or more operations per year.
- The airport is projected to meet any of the above criteria within 10 years.

According to the ADOT Aeronautics Division's 2000 records, 14 of the 16 airports in the MAG Regional Airport System are included in the Primary Airport System. The other two airports are included in the Secondary Airport System.

Secondary airports are normally located in rural areas. Because of their rural location, the smaller number of people in the area does not generate sufficient aviation activity to warrant the level of airport facilities generally associated with Primary airports. Secondary airports provide facilities that single-engine and light-twin aircraft can utilize. Secondary airports are not designed to serve business jets, heavy twin-engine aircraft, large commuter aircraft, or commercial airlines.

ADOT Airport Function Categories

Within both the Primary and Secondary Airport systems, ADOT further categorizes airports by their basic function. These categories and their definitions are as follows:

- Commercial Service Airport: This is a publicly owned airport that enplanes 2,500 or more passengers annually and receives scheduled passenger air service.

- Reliever Airport: This is an airport that serves to "relieve" of General Aviation traffic congestion at a Commercial Service airport, providing more general aviation access to the overall community. The

Reliever Airport should have a current or forecast activity level of 50 based aircraft and a minimum of 25,000 annual itinerant operations (or 35,000 local operations).

- General Aviation Airport: The airports that do not fall into either Commercial Service or Reliever status are referred to as General Aviation airports. This category includes privately owned and/or private-use airports/heliports. For system planning purposes, the General Aviation Airports are further divided into the following types:

  > Community Airport: This is an airport within the state of Arizona that serves an incorporated community with a population of more than 1,000 people.

  > Rural Airport: A rural airport is an airport within the state of Arizona that serves an incorporated community with less than 1,000 people.

  > Emergency Airport: This is an airport/facility or area within the state of Arizona that currently has or can demonstrate a need for an emergency or "air evacuation" airport. These airports may serve general aviation, recreation, and/or emergency services.

  > New Urban Airport: The construction of a new airport within 24 statute miles of the Urbanized Area Boundary of Phoenix, Tucson, Yuma, and Flagstaff requires the approval of the State Transportation Board. (Arizona Revised Statutes 28-8205)

Table 3.1 shows the current airport classifications for each airport in the MAG system.

Table 3.1
MAG Airport Classifications

Airport Name	NPIAS Classification	Airport Reference Code	ADOT Classifcation
Buckeye Municipal	General Aviation (GA)	B-II	Community
Chandler Municipal	Reliever (RL)	B-II	Reliever
Estrella Sailport	--	A-I	Rural
Gila Bend Municipal	General Aviation (GA)	B-II	Community
Glendale Municipal	Reliever (RL)	B-II	Reliever
Memorial	--	C-III	Community
Mesa Falcon Field	Reliever (RL)	B-II	Reliever
Phoenix-Deer Valley	Reliever (RL)	D-II	Reliever
Phoenix-Goodyear	Reliever (RL)	D-IV	Reliever
Phoenix-Sky Harbor International	Primary Service (PR)	D-V	Commercial Service
Pleasant Valley	--	B-I	Community
Scottsdale	Reliever (RL)	D-II	Reliever
Sky Ranch Carefree	--	B-I	Community
Stellar Airpark	--	B-II	Community
Wickenburg Municipal	General Aviation (GA)	B-I	Community
Williams Gateway	Reliever (RL)	D-V	Reliever

Source: Arizona Department of Transportation, FAA

AIRSIDE CAPACITY

An important goal in planning for airside or airfield improvements is to achieve an aviation system that offers a service level acceptable to both system users and operators. Service level is defined as the level of delay incurred by aircraft: the shorter the delay, the higher the service level. As aviation demand approaches airfield capacity, the delay incurred by aircraft increases and the quality of service deteriorates. Airfield demand/capacity analysis identifies the level of delay that could be incurred by system users. Results of demand/capacity analysis can be used to identify and subsequently evaluate system airfield improvements that will provide sufficient capacity to ensure that delays remain at acceptable levels within the system.

For system planning purposes, airfield capacity is typically expressed in an annual measure. The methodology used to estimate airfield capacity and associated aircraft delays in this study is based on each airport's physical layout and its operational characteristics and is referred to as annual service volume (ASV). This capacity methodology is documented in FAA Advisory Circular 150/5060-5, "Airport Capacity and Delay."

Annual Service Volume

ASV is defined as an estimate of an airport's annual operating capacity as defined by its ability to process aircraft activity. Operational capacity can be used as a reference point for general planning to determine when system enhancement is desirable from an operational perspective. ASV is useful in a system plan as it provides a comparative measure that is expressed in annual terms similar to forecasts developed for the study. The FAA uses ASV for long-range airport planning, which is the purpose of the RASP. ASV accounts for differences in runway use, aircraft mix, and weather conditions that would likely be encountered over a year's time. It is important to note that airports can exceed 100 percent of their capacity as defined by ASV, but the airport users are likely to experience a range of delay at points in the day when there is significant demand for the runway facilities. Prior to initiating development to address an identified operational capacity deficiency, more detailed analysis of delay would be needed at the individual airports.

As annual aircraft operations approach an airport's ASV, annual aircraft delays increase rapidly, with relatively small increases in aircraft activity. Under normal conditions, the FAA recommends that planning for additional capacity should begin when actual annual operations reach 60 percent of ASV. When the number of annual operations equals approximately 80 percent of ASV, additional capacity should be available. Providing additional capacity is typically accomplished through airfield improvements such as parallel runways or taxiways. Capacity saturation can also be addressed through methods of demand management, although airport operators are limited in their ability to impose demand management methods.

Another means used by the FAA and individual airports to examine capacity on a detailed level is hourly capacity. Hourly capacity is discussed in a subsequent section.

The FAA, MAG, and the respective airports provided specific ASV estimates. The capacity of each system airport was not calculated as part of the RASP.

The following sections describe the factors used in calculating ASVs for airports.

- Runway/Taxiway Configuration

Runway/taxiway configuration is the physical layout of runways and taxiways, including their number, orientation, location, and separation. Each configuration has a different capacity. Airport capacity increases with each additional runway depending on its wind coverage and its location relative to other existing runways. Parallel runways tend to have the highest operational capacity; the capacity of parallel runways also increases with the separation of the runway centerlines. Runways that converge or intersect have lower capacities because of operational interference which is inherent with this type of configuration. Taxiways increase capacity because they reduce the time aircraft need to be on the runway and improve access to landside facilities.

Eight of the airports covered by this study – Buckeye Municipal, Gila Bend Municipal, Glendale Municipal, Phoenix – Goodyear, Scottsdale, Sky Ranch Carefree, Stellar Airpark, and Wickenburg Municipal – have single runway configurations. Memorial has a primary and a crosswind runway. Chandler Municipal, Phoenix – Deer Valley, and Mesa Falcon Field feature dual parallel runways. Phoenix – Sky Harbor and Williams Gateway both have three parallel runway configurations. Estrella Sailport and Pleasant Valley both feature four dirt runways.

- Fleet Mix

The aircraft fleet mix is also an important factor in determining airport capacity. For capacity purposes, aircraft differ by approach speed and size. Capacity decreases as the diversity of aircraft approach speeds in the operational fleet mix increases, since aircraft following each other, either on takeoff or departure, are spaced according to their difference in airspeeds. Heavy (large) aircraft create wake vortices that require greater spacing between large and small aircraft. Wake vortices are typically not a factor at general aviation airports with homogeneous fleet mixes. The greater the difference in fleet size and speed, the greater the space required between aircraft, and therefore the lower the capacity. A single runway can process more demand if the operating fleet is fairly homogeneous in nature.

The FAA has four classifications of aircraft for the purposes of fleet mix calculations. Class A aircraft are single-engine aircraft that weigh 12,500 pounds or less. Class B aircraft are multi-engine aircraft that weigh 12,500 pounds or less. Both Class A and B aircraft are considered to generate a small amount of wake turbulence. Class C aircraft are multi-engine aircraft that weigh between 12,500 and 300,000 pounds. They generate a large amount of wake turbulence. Class D aircraft are multi-engine aircraft that weigh over 300,000 pounds. They are classified as heavy turbulence generators.

Buckeye Municipal, Estrella Sailport, Gila Bend Municipal, and Pleasant Valley have fleets composed of all single-engine aircraft, primarily Class A. Memorial, Sky Ranch Carefree, and Wickenburg Municipal have some activity by multiengine aircraft classified as Class B. Chandler Municipal, Glendale Municipal, Mesa Falcon Field, Phoenix – Goodyear, Stellar, and Williams Gateway have been noted to experience some multi-engine aircraft as well as some jet activity falling in Class C. Phoenix – Deer Valley, Phoenix – Sky Harbor, and Scottsdale all have a sizable amount of jet activity, including Class D.

- ASVs for MAG Airports

An ASV for each airport was provided by MAG, as collected from the airports during previous system planning efforts, and confirmed during the inventory phase of this project. The ASVs for the airports in the MAG system range from 120,000 to 660,000 and are presented in a subsequent table. It is important to note that ASVs can change at an airport without changes to the physical infrastructure. Increases or decreases in the level of flight training and changes in the operational fleet mix impact an airport's ASV. For this analysis, a static ASV was used for all airports throughout the planning period.

Aircraft Delays

Annual aircraft delay, expressed in minutes per aircraft operation, is an important measure of an airport's ability to accommodate projected aircraft operations. The relationships between the ratio of annual demand to ASV and average annual aircraft delay for general aviation airports are shown in **Table 3.2**:

Table 3.2
ASV and Aircraft Delay

Ratio of Annual Demand to ASV	Estimated Average Annual Aircraft Delay (minutes per operation)
0.1	0.0
0.2	0.1
0.3	0.2
0.4	0.3
0.5	0.4
0.6	0.6
0.7	0.8
0.8	1.2
0.9	1.8
1.0	2.8
1.1	5.6
1.2	10.0
1.3	15.0

Source: FAA Advisory Circular 150/5060-5

These relationships were derived from FAA Advisory Circular 150/5060-5, "Airport Capacity and Delay," and are based on traffic records and typical operational conditions for a number of high-capacity airports in the United States, especially those dominated by air carrier activity. As shown, when annual aircraft operations equal ASV (ratio of 1.0), average annual aircraft delay averages 2.8 minutes per aircraft. The actual delay at any given time depends on a number of conditions and can vary by a factor of five or more.

Tables 3.3, 3.4, 3.5, and **3.6** show the relationships between ASV and operations for the MAG airports, as well as the average annual aircraft delay for 2000, and forecasts for those figures in 2005, 2015, and 2025. **Table 3.7** summarizes the capacity and demand relationships at each airport for those years. Based on these capacity-to-delay ratios, only two of the airports in this study are currently experiencing an average level of delay greater than one minute: Phoenix–Sky Harbor and Scottsdale. Scottsdale, in fact, is experiencing an average annual delay of about five minutes per aircraft operation. By the end of the planning period, Chandler Municipal, Mesa Falcon Field, Phoenix–Deer Valley, Phoenix–Goodyear, Phoenix–Sky Harbor International, Pleasant Valley, Scottsdale, and Williams Gateway are all projected to experience average aircraft delays of greater than one minute. Furthermore, Glendale Municipal will approach a one-minute delay per aircraft operation by the end of the planning period.

The FAA is currently focusing on delay at airports where the average delay level approaches seven minutes per operation, especially at large commercial service airports. Airports with delay in the four-minute range are considered to be operating at an "acceptable" level of delay.

As shown in Table 3.7, from 2000 to 2025, the ratio of annual demand to ASV will increase from 48.5 percent to 83.9 percent (first scenario) or 87.3 percent (second scenario) for the entire Region.

If a significant number of aircraft training operations occur at an airport, the demand-to-capacity ratio may be driven up although training operations (such as a touch-and-go) certainly do not tax an airport's capacity as much as a normal takeoff and landing. The airports that are forecasted in 2025 to have at least a 60 percent demand-to-capacity ratio and with 50 percent of the operations being local general aviation operations include Buckeye Municipal, Chandler Municipal, Glendale Municipal, Phoenix–Deer Valley, Phoenix–Goodyear, Pleasant Valley, and Williams Gateway. Instead of approving facilities to increase capacity at these airports, the FAA generally recommends these airports divert some of their training operations to other nearby airports, as practical.

Table 3.3
2000 Operational Demand

Airport Name	ASV	2000 Annual Operations	Annual Demand To ASV Ratio	Average Aircraft Delay (Minutes)
Buckeye Municipal	315,560	90,000	0.3	0.2
Chandler Municipal	460,000	249,811	0.5	0.4
Estrella Sailport	120,000	16,500	0.1	0
Gila Bend Municipal	212,797	52,000	0.2	0.1
Glendale Municipal	257,972	112,570	0.4	0.3
Memorial	100,000	2,300	0.0	0
Mesa Falcon Field	443,000	274,665	0.6	0.6
Phoenix-Deer Valley	606,000	370,779	0.6	0.6
Phoenix-Goodyear	304,916	142,458	0.5	0.4
Phoenix-Sky Harbor International	660,000	579,846	0.9	1.8
Pleasant Valley	120,000	52,000	0.4	0.3
Scottsdale	200,000	215,585	1.1	5.6
Sky Ranch Carefree	174,000	4,732	0.0	0
Stellar Airpark	286,700	40,880	0.1	0
Wickenburg Municipal	245,000	19,846	0.1	0
Williams Gateway	410,000	158,489	0.4	0.3
Total - All Airports	4,915,945	2,382,461	0.5	---

Source: Airport master plans, airport operator estimates, FAA Advisory Circular 150/5060-5, FAA air traffic control tower records, Maricopa Association of Governments

Table 3.4
2005 Projected Operational Demand

Airport Name	ASV	2005 Annual Operations	Annual Demand To ASV Ratio	Average Aircraft Delay (Minutes)
Buckeye Municipal	315,560	114,200	0.4	0.3
Chandler Municipal	460,000	286,700	0.6	0.6
Estrella Sailport	120,000	16,500	0.1	0
Gila Bend Municipal	212,797	55,300	0.3	0.2
Glendale Municipal	257,972	128,100	0.5	0.4
Memorial	100,000	3,400	0.0	0
Mesa Falcon Field	443,000	316,100	0.7	0.8
Phoenix-Deer Valley	606,000	389,400	0.6	0.6
Phoenix-Goodyear	304,916	173,100	0.6	0.6
Phoenix-Sky Harbor International				
Scenario 1	660,000	626,700	0.9	1.8
Scenario 2	660,000	662,500	1.0	2.8
Pleasant Valley	120,000	64,600	0.5	0.4
Scottsdale	200,000	237,000	1.2	10
Sky Ranch Carefree	174,000	6,100	0.0	0
Stellar	286,700	45,800	0.2	0.1
Wickenburg Municipal	245,000	26,000	0.1	0
Williams Gateway	410,000	270,100	0.7	0.8
Total - All airports, Scenario 1	4,915,945	2,759,100	0.6	---
Total - All airports, Scenario 2	4,915,945	2,794,900	0.6	---

Source: Airport master plans, FAA Advisory Circular 150/5060-5, Maricopa Association of Governments, Wilbur Smith Associates

Table 3.5
2015 Projected Operational Demand

Airport Name	ASV	2015 Annual Operations	Annual Demand To ASV Ratio	Average Aircraft Delay (Minutes)
Buckeye Municipal	315,560	164,700	0.5	0.4
Chandler Municipal	460,000	400,600	0.9	1.8
Estrella Sailport	120,000	16,500	0.1	0
Gila Bend Municipal	212,797	56,500	0.3	0.2
Glendale Municipal	257,972	162,600	0.6	0.6
Memorial	100,000	4,400	0.0	0
Mesa Falcon Field	443,000	394,100	0.9	1.8
Phoenix-Deer Valley	606,000	515,000	0.8	1.2
Phoenix-Goodyear	304,916	253,600	0.8	1.2
Phoenix-Sky Harbor International				
Scenario 1	660,000	670,100	1.0	2.8
Scenario 2	660,000	761,500	1.2	10
Pleasant Valley	120,000	99,400	0.8	1.2
Scottsdale	200,000	248,900	1.2	10
Sky Ranch Carefree	174,000	9,500	0.1	0
Stellar	286,700	62,100	0.2	0.1
Wickenburg Municipal	245,000	32,000	0.1	0
Williams Gateway	410,000	372,900	0.9	1.8
Total - All airports, Scenario 1	4,915,945	3,462,900	0.7	---
Total - All airports, Scenario 2	4,915,945	3,554,300	0.7	---

Source: Airport master plans, FAA Advisory Circular 150/5060-5, Maricopa Association of Governments, Wilbur Smith Associates

Table 3.6
2025 Projected Operational Demand

Airport Name	ASV	2025 Annual Operations	Annual Demand To ASV Ratio	Average Aircraft Delay (Minutes)
Buckeye Municipal	315,560	215,200	0.7	0.8
Chandler Municipal	460,000	514,500	1.1	5.6
Estrella Sailport	120,000	16,500	0.1	0
Gila Bend Municipal	212,797	57,800	0.3	0.2
Glendale Municipal	257,972	197,000	0.8	1.2
Memorial	100,000	5,500	0.1	0
Mesa Falcon Field	443,000	472,100	1.1	5.6
Phoenix-Deer Valley	606,000	640,600	1.1	5.6
Phoenix-Goodyear	304,916	334,200	1.1	5.6
Phoenix-Sky Harbor International				
Scenario 1	660,000	724,400	1.1	5.6
Scenario 2	660,000	892,100	1.4	15
Pleasant Valley	120,000	134,300	1.1	5.6
Scottsdale	200,000	262,600	1.3	10
Sky Ranch Carefree	174,000	13,000	0.1	0
Stellar	286,700	78,400	0.3	0.2
Wickenburg Municipal	245,000	38,100	0.2	0.1
Williams Gateway	410,000	420,300	1.0	2.8
Total - All airports, Scenario 1	4,915,945	4,124,500	0.8	---
Total - All airports, Scenario 2	4,915,945	4,292,200	0.9	---

Source: Airport master plans, FAA Advisory Circular 150/5060-5, Maricopa Association of Governments, Wilbur Smith Associates

Table 3.7
Annual Service Volume Capacity Analysis

		Existing		2005		2015		2025	
Airport Name	ASV	Annual Operations	% Capacity Utilized	Annual Operations	% Capacity Utilized	Annual Operations	% Capacity Utilized	Annual Operations	% Capacity Utilized
Buckeye Municipal	315,560	90,000	28.5%	114,200	36.2%	164,700	52.2%	215,200	68.2%
Chandler Municipal	460,000	249,811	54.3%	286,700	62.3%	400,600	87.1%	514,500	111.8%
Estrella Sailport	120,000	16,500	13.8%	16,500	13.8%	16,500	13.8%	16,500	13.8%
Gila Bend Municipal	212,797	52,000	24.4%	55,300	26.0%	56,500	26.6%	57,800	27.2%
Glendale Municipal	257,972	112,570	43.6%	128,100	49.7%	162,600	63.0%	197,000	76.4%
Memorial	100,000	2,300	2.3%	3,400	3.4%	4,400	4.4%	5,500	5.5%
Mesa Falcon Field	443,000	274,665	62.0%	316,100	71.4%	394,100	89.0%	472,100	106.6%
Phoenix-Deer Valley	606,000	370,779	61.2%	389,400	64.3%	515,000	85.0%	640,600	105.7%
Phoenix-Goodyear	304,916	142,458	46.7%	173,100	56.8%	253,600	83.2%	334,200	109.6%
Phoenix-Sky Harbor International	660,000	579,846	87.9%						
Scenario 1				626,700	95.0%	670,100	101.5%	724,400	109.8%
Scenario 2				662,500	100.4%	761,500	115.4%	892,100	135.2%
Pleasant Valley	120,000	52,000	43.3%	64,600	53.8%	99,400	82.8%	134,300	111.9%
Scottsdale	200,000	215,585	107.8%	237,000	118.5%	248,900	124.5%	262,600	131.3%
Sky Ranch Carefree	174,000	4,732	2.7%	6,100	3.5%	9,500	5.5%	13,000	7.5%
Stellar Airpark	286,700	40,880	14.3%	45,800	16.0%	62,100	21.7%	78,400	27.3%
Wickenburg Municipal	245,000	19,846	8.1%	26,000	10.6%	32,000	13.1%	38,100	15.6%
Williams Gateway	410,000	158,489	38.7%	270,100	65.9%	372,900	91.0%	420,300	102.5%
Total - All Airports	4,915,945	2,382,461	48.5%						
Total - All Airports, Scenario 1				2,759,100	56.1%	3,462,900	70.4%	4,124,500	83.9%
Total - All Airports, Scenario 2				2,794,900	56.9%	3,554,300	72.3%	4,292,200	87.3%

Source: Airport master plans, Airport operator estimates, FAA Advisory Circular 150/5060-5, FAA air traffic control tower records, Maricopa Association of Governments, Wilbur Smith Associates

Hourly Runway Capacity

Hourly runway capacity is the maximum number of aircraft operations that can take place on a runway or group of runways in an hour for a given use configuration, weather condition, and aircraft fleet mix. An airport's hourly capacity is important because aircraft delays are affected not only by the total number of aircraft operations in a year, but also by the way aircraft operations are distributed on a daily and hourly basis. The factors that affect hourly runway capacity include the following:

- Runway configuration
- Noise abatement procedures that restrict which aircraft can use certain runways
- Fleet mix
- Weather conditions including wind
- Runway occupancy times
- Airspace interaction

Generally, hourly runway capacity is an important factor for commercial service airports such as Phoenix–Sky Harbor International Airport. According to the FAA's 2001 capacity benchmarks, the current capacity at Sky Harbor is 137 to 146 flights per hour in good weather conditions and 96 to 101 flights per hour in adverse weather conditions. The recently opened third runway increased good weather capacity by 36 percent and adverse weather capacity by 60 percent. According to the FAA, as a result of the addition of the third runway, Sky Harbor now operates below its good and adverse weather capacities throughout the day.

Table 3.8 presents the existing and projected annual operational estimates for Sky Harbor translated into peak hour operation estimates. Considering the high percentage of good weather conditions in Phoenix on an average basis, it appears that from an hourly capacity standpoint that the airport will surpass its estimated hourly capacity in good weather in 2005. This indicates that capacity is likely to be an issue at Sky Harbor in the near term.

Table 3.8
Phoenix-Sky Harbor International Airport Hourly Capacity

Years (Scenario)	Annual Operations	Peak Month	Design Day	Peak Hour
2000	579,846	52,186	1,740	139
2005 (Scenario 1)	626,700	56,403	1,880	150
2005 (Scenario 2)	662,500	59,625	1,988	159
2015 (Scenario 1)	670,100	60,309	2,010	161
2015 (Scenario 2)	761,500	68,535	2,285	183
2025 (Scenario 1)	724,400	65,196	2,173	174
2025 (Scenario 2)	892,100	80,289	2,676	214

Sources: Phoenix-Sky Harbor International Airport, Wilbur Smith Associates

FACILITY REQUIREMENTS

Projected growth in the existing MAG system's demand will continue to generate a need for system improvements. To prepare for this growth, existing airside and landside facilities at each of the system airports were evaluated using planning standards to determine their ability to meet existing and projected aviation demand. Facilities were identified by airport for the following components:

- Runway length requirements
- Runway width requirements
- Runway strength requirements
- Runway design standards
- Parallel taxiway requirements
- Navigational aid (NAVAID) requirements
- Aircraft storage requirements
- Commercial space requirements

Each of the above components is discussed in the following sections.

Runway Length Requirements

Runway length is a function of the airport's normal mean maximum temperature, elevation, and the length of haul performed by aircraft operating on that runway. The length of haul to be flown by an aircraft impacts the takeoff weight of the aircraft: a longer haul requires the aircraft to carry more fuel, thereby increasing the aircraft's weight and the length of takeoff runway required.

Runway length is a crucial factor in evaluating an airport's ability to accommodate the type of aircraft it is projected to serve. Consequently, available runway length was examined in relation to each airport's designated role. The FAA Airport Design computer software program (Version 4.2D) provides runway length requirements and was used to determine the required primary runway length for each of the airports in the MAG system.   The FAA's computer software program recommends runway lengths based upon input of the airport's elevation, the airport's normal mean maximum temperature, and the length of haul performed by aircraft at the airport. From this information, the program produces recommended runway lengths for different aircraft types that may be accommodated at the airport. The FAA's program produces nine runway length options including the following:

- 75 % of small airplanes with less than 10 passenger seats
- 95% of small airplanes with less than 10 passenger seats
- 100% of small airplanes with less than 10 passenger seats
- Small airplanes with 10 or more passenger seats
- 75% of large airplanes at 60% useful load
- 75% of large airplanes at 90% useful load
- 100% of large airplanes at 60% useful load
- 100% of large airplanes at 90% useful load
- Airplanes of more than 60,000 lbs.

Of the nine options, the following were used as the requirement for the airports based on their current ARC:

- ARC: A-I or B-I – 95% of small airplanes with less than 10 passenger seats
- ARC: A-II or B-II – 100% of small airplanes with less than 10 passenger seats
- ARC: C-I or C-II – 75% of large airplanes at 60% useful load
- ARC: C-III – 100% of large airplanes at 60% useful load
- ARC: D-I or D-II – 100% of large airplanes at 60% useful load
- ARC: D-IV or D-V – 100% of large airplanes at 90% useful load

The FAA recommends rounding the runway length requirements to the nearest hundred.

Table 3.9 presents these recommended runway lengths, as well as the existing primary runway lengths for each airport.

Table 3.9
Primary Runway Length Analysis

Airport Name	Airport Reference Code	Existing Primary Runway Length (feet)	Recommended Primary Runway Length (feet)
Buckeye Municipal	B-II	4,300	4,300
Chandler Municipal	B-II	4,850	4,400
Estrella Sailport	A-I	3,740	3,700
Gila Bend Municipal	B-II	5,200	4,200
Glendale Municipal	B-II	5,350	4,300
Memorial	C-III	8,577	6,700
Mesa Falcon Field	B-II	5,100	4,400
Phoenix-Deer Valley	D-II	8,200	7,100
Phoenix-Goodyear	D-IV	8,500	8,200
Phoenix-Sky Harbor International	D-V	11,001	11,000
Pleasant Valley	B-I	3,657	3,800
Scottsdale	D-II	8,251	7,000
Sky Ranch Carefree	B-I	4,437	4,400
Stellar Airpark	B-II	4,005	4,400
Wickenburg Municipal	B-I	5,050	4,300
Williams Gateway	D-V	9,300	11,000

Source: FAA, Maricopa Association of Governments, Wilbur Smith Associates

According to this program, three of the area's airports have primary runways that are not long enough: Pleasant Valley, Stellar Airpark, and Williams Gateway.

Runway Width Requirements

The FAA developed runway width criteria based on Airport Reference Codes. That is, all airports with an ARC of B-II have the same required primary runway width, and this is different from the required primary runway width required for airports with an ARC of D-V. **Table 3.10** shows the primary runway width at each airport, as well as the recommended width for each of those runways based on the airport's ARC. Based on the FAA recommendations, three of the area airports have primary runway widths that do not meet recommended FAA runway width criteria: Estrella Sailport, Sky Ranch Carefree, and Stellar Airpark. All three of these airports are not part of the National Plan of Integrated Airport Systems (NPIAS) and therefore are not required to meet FAA standards because they are not eligible for Federal funding.

Table 3.10
Primary Runway Width Analysis

Airport Name	Airport Reference Code	Existing Primary Runway Width (feet)	Recommended Primary Runway Width (feet)
Buckeye Municipal	B-II	75	75
Chandler Municipal	B-II	75	75
Estrella Sailport	A-I	50	60
Gila Bend Municipal	B-II	75	75
Glendale Municipal	B-II	75	75
Memorial	C-III	200	100
Mesa Falcon Field	B-II	100	75
Phoenix-Deer Valley	D-II	100	100
Phoenix-Goodyear	D-IV	150	150
Phoenix-Sky Harbor International	D-V	150	150
Pleasant Valley	B-I	100	60
Scottsdale	D-II	100	100
Sky Ranch Carefree	B-I	50	60
Stellar Airpark	B-II	60	75
Wickenburg Municipal	B-I	75	60
Williams Gateway	D-V	150	150

Source: FAA, Maricopa Association of Governments

Runway Strength Requirements

Runway pavement strength is defined for single-wheel, dual-wheel, dual-tandem, and double dual-tandem loading. An aircraft's gear type and configuration dictates how that aircraft's weight is distributed to the pavement and also determines pavement response to loading. Examination of gear configuration, tire contact areas, and tire pressure in common use indicate that pavement strength is related to aircraft maximum takeoff weight. Therefore, airports that accommodate heavy aircraft must have pavements capable of accommodating the additional pavement loading.

The required pavement strength of the primary runway at an airport was determined by examining the airport's ARC and typical aircraft that fall within each ARC. These requirements are reported in **Table 3.11**. By this standard, Buckeye Municipal, Gila Bend Municipal, Memorial, and Pleasant Valley all have primary runways that do not meet minimum strength requirements.

Table 3.11
Primary Runway Strength Analysis

Airport Name	Airport Reference Code	Existing Primary Runway Strength	Ability to Meet Minimum Strength Requirement
Buckeye Municipal	B-II	12.5S	☐
Chandler Municipal	B-II	30S	■
Estrella Sailport	A-I	DIRT	■
Gila Bend Municipal	B-II	12.5S	☐
Glendale Municipal	B-II	30S, 37.5D	■
Memorial	C-III	1/	☐
Mesa Falcon Field	B-II	38S, 50D	■
Phoenix-Deer Valley	D-II	40S, 50D, 80DT	■
Phoenix-Goodyear	D-IV	200D	■
Phoenix-Sky Harbor International	D-V	30S, 170D, 280DT, 620DDT	■
Pleasant Valley	B-I	DIRT	☐
Scottsdale	D-II	45S, 75D	■
Sky Ranch Carefree	B-I	12.5S	■
Stellar Airpark	B-II	1/	■
Wickenburg Municipal	B-I	16S	■
Williams Gateway	D-V	75S, 210D, 590DT, 850DDT	■
	■ Airport meets standard		
	☐ Airport does not meet standard		

1/ The precise strengths are not available for either of these airports. It is likely that Memorial's runway strength is not sufficient to meet the demand of C-III aircraft types based on its existing condition.
Source: Airports, MAG, FAA, US Government Flight Information Publication Airport/Facility Directory, Wilbur Smith Associates

Runway-Taxiway Separation Standards

The design of a runway is based on the type of aircraft that are intended to operate at the airport on a regular basis. As noted earlier in this chapter, the FAA uses a system referred to as ARC to relate airport design criteria to the operational and physical characteristics of the aircraft. Previous sections have identified requirements for runway length, width, and strength. In order for an airport to function safely and efficiently, its facilities should be developed to meet the FAA's standards. In addition to length, width, and strength, a runway should be located separate from other facilities such as taxiways, buildings, and obstructions to permit its safe use.

The FAA sets forth separation criteria for runways and parallel taxiways and taxilanes to allow for the safe operation of aircraft on the runway system. As the design group (based on aircraft wingspan and depicted by a Roman numeral) of the aircraft that operate at the airport increases, the distance between the runway centerline and the centerline of the taxiway or taxilane also increases. These separation standards coincide with other FAA safety area requirements including runway safety area, obstacle free zone, and object free area. In addition to the design group, the aircraft approach categories (based on aircraft speed and depicted by a letter) and the approach visibility minimums are also used to determine the runway separation standards. Similar to the design group, as the aircraft approach category increases and the visibility minimums decrease, the separation requirements increase.

Table 3.12 presents the runway/taxiway separation standards for the respective system airports. Only the runway to taxiway separation distance was examined for purposes of the RASP. If an airport's runway to taxiway separation is not sufficient, it is likely that the airport does not meet other FAA safety area requirements.

Table 3.12
Runway-Taxiway Separation Standards Analysis

Airport Name	Airport Reference Code	Visibility Minima	Existing Separation	Ability to Meet Separation Requirement
Buckeye Municipal	B-II	3 miles	400	■
Chandler Municipal	B-II	1 mile	240	■
Estrella Sailport	A-I	3 miles	N/A	N/A
Gila Bend Municipal	B-II	3 miles	250	□
Glendale Municipal	B-II	1 mile	240	□[1/]
Memorial	C-III	3 miles	N/A	N/A
Mesa Falcon Field	B-II	1 mile	200	□[1/]
Phoenix-Deer Valley	D-II	1 ¼ miles	200	■
Phoenix-Goodyear	D-IV	3 miles	400	■
Phoenix-Sky Harbor International	D-V	½ mile	400	■
Pleasant Valley	B-I	3 miles	N/A	N/A
Scottsdale	D-II	1 mile	240	□[1/]
Sky Ranch Carefree	B-I	3 miles	N/A	N/A
Stellar Airpark	B-II	3 miles	N/A	N/A
Wickenburg Municipal	B-I	3 miles	200	□
Williams Gateway	D-V	1 mile	400	□[2/]

■ Airport meets standard
□ Airport does not meet standard

[1/] The FAA has issued a modification to standard for this separation standard requirement.
[2/] The recently constructed partial parallel taxiway has a separation distance of 400 feet, but the remainder does not.
Source: Airports, MAG, FAA, US Government Flight Information Publication Airport/Facility Directory, Wilbur Smith Associates

Separation standards were not analyzed at the non-NPIAS airports, as they are not required to meet FAA standards. Of the NPIAS airports, three do not meet the FAA's standards for runway to taxiway separation, and two airports (Mesa Falcon Field and Scottsdale) have modifications to standard issued by the FAA. A modification to design standards is issued by the FAA only in cases where significant review of the standard deviation has occurred and concurrence was reached that the deviation could not be addressed effectively, but that safety was not an issue.

Taxiway Requirements

Similar to paved runways, parallel taxiways enhance the operational characteristics of an airport, provide additional airfield capacity, and improve the overall safety of the airfield. A full parallel taxiway with appropriately spaced exits enables landing aircraft to clear the runway quickly, thus accommodating a larger number of operations.

The capacity of the taxiway system may be a limiting operational factor at an airport. Taxiways link the independent airport elements and require careful planning for optimum airport utility. The taxiway system should provide for free movement to and from the runways, terminal/cargo, and parking areas. It is desirable to maintain a smooth flow with a minimum number of points requiring a change in the airplane's taxiing speed.

The FAA emphasizes seven principles in designing a taxiway system. They are the following:

- Provide each runway with a parallel taxiway or the capability therefore
- Build taxiways as direct as possible
- Provide bypass capability or multiple access to runway ends
- Minimize crossing runways
- Provide ample curve and fillet radii
- Provide airport traffic control tower line of sight
- Avoid traffic bottlenecks

Curve and fillet radii refer to the radius of the exit taxiway pavement that provides access from the runway to the taxiway. In general, there are two types of exit taxiways: right angle, and acute-angle. A decision to provide a right-angled exit taxiway or a standard acute-angled taxiway rests upon an analysis of the existing and contemplated traffic. The purpose of an acute-angled exit taxiway, commonly referred to as a "high speed exit," is to enhance airport capacity. Acute-angled exit taxiways increase capacity relative to right- angled exit taxiways because airplanes do not have to slow down as much when transitioning to the exit taxiway nearly as much as for a right-angled taxiway.

Taxiways can be either full or partial, in length relative to the length of the runway. A full-length taxiway provides greater capacity, provided it has adequate numbers and spacing of exit taxiways because it allows landing airplanes to exit the runway more expeditiously. **Table 3.13** presents the taxiway information for the primary runway at each airport in addition to the type of taxiway (full, partial, or none). Based upon this measure, Pleasant Valley (with 52,000 operations in 2000 and no parallel taxiway) and Williams Gateway do not fulfill the minimum parallel taxiway requirement.

Table 3.13
Taxiway Analysis (Primary Runway)

Airport Name	ARC	Existing Taxiway Length Relative to Primary Runway	Existing Number of Taxiway Exits	Ability to Meet Minimum Taxiway Length Requirement
Buckeye Municipal	B-II	Full	5	■
Chandler Municipal	B-II	Full	8	■
Estrella Sailport	A-I	None	0	■
Gila Bend Municipal	B-II	Partial	3	■
Glendale Municipal	B-II	Full	8	■
Memorial	C-III	Full	3	■
Mesa Falcon Field	B-II	Full	9	■
Phoenix - Deer Valley	D-II	Full	12	■
Phoenix - Goodyear	D-IV	Full	10	■
Phoenix - Sky Harbor International	D-V	Full	12	■
Pleasant Valley	B-I	None	0	□
Scottsdale	D-II	Full	14	■
Sky Ranch Carefree	B-I	Full	5	■
Stellar Airpark	B-II	Full	2	■
Wickenburg Municipal	B-I	Full	6	■
Williams Gateway	D-V	Partial	4	□

■ Airport meets standard
□ Airport does not meet standard

Source: FAA, Maricopa Association of Governments, Wilbur Smith Associates

Navigational Aid (NAVAID) Requirements

NAVAIDs provide approaching aircraft with either precision guidance to a specific runway end and/or nonprecision guidance to a runway or the airport itself. A precision NAVAID provides electronic descent, alignment (course), and guidance information, while a nonprecision NAVAID provides only alignment and position information. The necessity to provide precision, nonprecision, or both capabilities at an airport is usually determined by design standards, based on safety considerations and airport operational needs. The type, mission, and volume of aeronautical activity in association with meteorological, airspace, and capacity data are the factors used to determine an airport's NAVAID requirements. For this study, airport upgrades to meet commercial service and economic development criteria are the driving factors for providing additional precision instrument approach capabilities.

Airport lighting greatly enhances airport utilization and safety. For nighttime operations, an airport should, at minimum, have a lighted wind direction indicator, runway lighting, and a rotation beacon. A number of visual aids are available to assist in locating a runway at night or during periods of reduced visibility. In general, lighting and NAVAIDs vary by airport type and category.

Historically, the basis for establishing instrument approach capabilities at an airport was related to the number of annual instrument approaches to the airport and considered factors such as the role of the airport, activity levels, its contribution to the overall economic stability of the service area, and the life-cycle cost of establishing, maintaining, and operating the equipment. Incremental gains in airport and runway operational capability achieved as a result of lowering approach minimums would also be incorporated into the analysis. In this manner, a matrix of airport role/activity levels/desired instrument approach capabilities could be defined. The next step in the process would be to evaluate means to achieve the desired instrument approach capability if it was not currently met.

The introduction of Global Positioning System (GPS) technology to civil aviation use necessitates a re-examination of this traditional approach, since the GPS signal is satellite-generated, thereby eliminating the relatively high cost of establishing and maintaining a ground-based NAVAID. Furthermore, new standards associated with the airport landing surface e and runway facility design to support new instrument approach procedures have been issued by the FAA. Although these standards have been in effect to evaluate other physical and facility needs at the airport, their recent tie to achievable ceiling and visibility minimums serves to strengthen their importance with respect to the establishment of instrument approach procedures.

In **Table 3.14**, current NAVAIDs and recommendations from the "Navigational Aids and Aviation Services Special Study," which was published by the ADOT Aeronautics Division in November 1998, are reported for each airport. Airport eligibility for RNAV / GPS, ALS, and VASI / PAPI systems were also from this study. REIL and HIRL determinations are based on FAA Order 7031.2C.

Table 3.14
Navigational Aids Analysis

Airport Name	ILS	LOC	RNAV / GPS	NDB	VOR	DME	ALS	VASI / PAPI	REIL	HIRL	MIRL	LIRL
Buckeye Municipal			□[2]					■	□		■	
Chandler Municipal			■[2]□[1]	■	■		□	■	■	□	■	
Estrella Sailport								□	□			
Gila Bend Municipal			□[2]					□	□		■	
Glendale Municipal			■[2]□[1]				□	■	■	□	■	
Memorial			□[2]					□				
Mesa Falcon Field			■[2]□[1]	■			□	■	■	□	■	
Phoenix-Deer Valley			■[2]□[1]	■			□	■	■	□	■	
Phoenix-Goodyear			□[1]				□	■	■	□	■	
Phoenix-Sky Harbor International	■	■	■		■	■	■	■	■	■		
Pleasant Valley			□[2]					□	□		□	
Scottsdale			□[1]	■	■		□	■	■	□	■	
Sky Ranch Carefree								□				
Stellar Airpark			■[2]		■			■	■		■	
Wickenburg Municipal			□[2]					■	□		■	
Williams Gateway	■		■[2]		■		■	■	■	■	■	

■ Existing
□ Eligible for according to ADOT Study
[1] Precision approach
[2] Nonprecision approach

Source: FAA Advisory Circular 150 / 5300-2D, FAA Order 7031.2C, Navigational Aids and Aviation Services Special Study (Arizona Department of Transportation)

Seven area airports already have RNAV or GPS. The "Navigational Aids and Aviation Services Special Study" recommended that any airports with either a precision or nonprecision approach should have GPS. As a result, GPS approaches were identified at the other seven airports that have a nonprecision approach: Buckeye Municipal, Gila Bend Municipal, Memorial, Phoenix–Goodyear, Pleasant Valley, Scottsdale, and Wickenburg Municipal.

Currently, Phoenix–Sky Harbor International and Williams Gateway have approach lighting systems (ALS). However, the cost-benefit analysis in the "Navigational Aids and Aviation Services Special Study" indicates that ALS would be economically justified at Chandler Municipal, Glendale Municipal, Mesa Falcon Field, Phoenix–Deer Valley, Phoenix–Goodyear, and Scottsdale.

Most of the airports already have existing VASI or PAPI configurations. The airports that do not are Estrella Sailport, Gila Bend Municipal, Memorial, Pleasant Valley, and Sky Ranch Carefree. The "Navigational Aids and Aviation Services Special Study" recommends that each of these airports install a visual approach guidance system.

FAA Order 7031.2C states that REILs are justified at any airport that has at least 7,300 annual general aviation operations. The area airports that fit this criterion but do not have existing REILs are Buckeye Municipal, Estrella Sailport, Gila Bend Municipal, Pleasant Valley, and Wickenburg Municipal.

Typically, airports that have a precision approach have HIRL to support the approach. Williams Gateway is the only airport that has ILS, but not HIRL. Furthermore, it was assumed that if the "Navigational Aids and Aviation Services Special Study" recommended ALS for an airport, then HIRL would also be recommended. Therefore, Chandler Municipal, Glendale Municipal, Mesa Falcon Field, Phoenix–Deer Valley, Phoenix–Goodyear, Scottsdale, and Williams Gateway also need HIRL. MIRL is also recommended for Pleasant Valley due to because of the substantial number of operations at that airport.

Aircraft Storage Requirements

Demand for hangar storage at airports is directly related to climate and the type of aircraft based at each airport. Areas with more severe weather conditions have a higher demand for hangar storage facilities. High-cost twin-engine and jet aircraft also increase demand for hangar storage. Each airport provides different levels and types of storage for based aircraft depending on the land envelope available at each airport.

Additional aircraft storage can be facilitated by the construction of new hangars, as well as by additional tie-down ramp area. For the purposes of this study, it was assumed that one acre could provide enough space for 10 T-hangars. Based on the forecasts of based aircraft at each airport in 2015 and 2025, projections were made for the additional acreage required at each airport to support the construction of new aircraft storage facilities to accommodate the increase in based aircraft. Aerial photographs of each airport were then used to estimate how many unused acres of land surround each airport. Each airport was then judged in its ability to accommodate its respective future storage requirements.

Table 3.15 presents the forecasted increases in based aircraft at each airport in 2005, 2015, and 2025, the amount of additional space required to house these aircraft, and whether each airport is capable of accommodating it. Only three of the airports appear to have potential storage problems: Mesa Falcon Field, Phoenix–Deer Valley, and Stellar Airpark. Mesa Falcon Field has ample land immediately surrounding the runways, but its ability to build aircraft storage buildings is reduced by the surrounding streets that box in the airport. Phoenix–Deer Valley has ample open space on one side, but buildings are nearby on the other three sides. The large amount of additional acreage needed at this airport in 2025 (87.8 acres) makes it unclear whether the open space will provide enough room for the additional aircraft storage buildings. Streets on two opposite sides and buildings on the other two sides surround Stellar Airpark. However, there may be enough space on the airport land itself to build the required aircraft storage areas.

Table 3.15
Aircraft Storage Analysis

Airport Name	Additional Based Aircraft 2000-2015	Additional Based Aircraft 2015-2025	Additional Req'd Acreage 2000-2015	Additional Req'd Acreage 2015-2025	Total Additional Req'd Acreage 2000-2025	Ability to Facilitate Demand - 2025
Buckeye Municipal	46	31	4.6	3.1	7.7	■
Chandler Municipal	237	178	23.7	17.8	41.5	■
Estrella Sailport	0	0	0	0	0	■
Gila Bend Municipal	7	2	0.7	0.2	0.9	■
Glendale Municipal	92	64	9.2	6.4	15.6	■
Memorial	7	4	0.7	0.4	1.1	■
Mesa Falcon Field	401	262	40.1	26.2	66.3	◘
Phoenix - Deer Valley	469	409	46.9	40.9	87.8	◘
Phoenix - Goodyear	218	159	21.8	15.9	37.7	■
Phoenix - Sky Harbor International	-54	-48	-5.4	-4.8	-10.2	■
Pleasant Valley	41	30	4.1	3	7.1	■
Scottsdale	25	23	2.5	2.3	4.8	■
Sky Ranch Carefree	85	61	8.5	6.1	14.6	■
Stellar Airpark	79	60	7.9	6	13.9	◘
Wickenburg Municipal	19	10	1.9	1	2.9	■
Williams Gateway	145	93	14.5	9.3	23.8	■

■ Appears capable of meeting future demand
◘ Possibly capable of meeting future demand
☐ Unable to meet future demand

Source: Arizona Department of Transportation, Wilbur Smith Associates

Commercial Space Requirements

Terminal building needs were examined for the airports in the RASP with commercial service. The analysis focused on the commercial airports in the Region including Phoenix-Sky Harbor International, Scottsdale, and Williams Gateway. These three airports were identified as having existing commercial enplanements and were projected to continue to serve as commercial passenger airports in the future. For Phoenix-Sky Harbor International, parking and airfreight needs were also examined.

Terminal area requirements at general aviation airports reflect the space needed to accommodate airport management and airport user functions, including general aviation pilots, passengers, and airport visitors. This space includes an airport management office and operations area, waiting area, pilot lounge, concessions, restrooms, circulation, and utilities. At most general aviation airports, a fixed based operator (FBO) provides these facilities. However, these facilities are not necessarily limited to being housed in one building. Terminal building requirements were not examined on the ability of the commercial service airports to provide sufficient space for terminal building needs based on the projected increases in enplanements.

- Terminal Building

Terminal area requirements at general aviation airports reflect the space needed to accommodate airport management and airport user functions, including general aviation pilots, passengers, and airport visitors. This space includes an airport management office and operations area, waiting area, pilot lounge, concessions, restrooms, circulation, and utilities. At most general aviation airports, a fixed based operator (FBO) provides these facilities. However, these facilities are not necessarily limited to being housed in one building. Terminal building requirements were not examined in this analysis for the general aviation airports. The focus of this analysis was on the ability of the commercial service airports to provide sufficient space for terminal building needs based on the projected increases in enplanements.

Table 3.16 shows the current and projected (for 2005, 2015, and 2025) commercial passenger enplanements at Phoenix–Sky Harbor International, Scottsdale, and Williams Gateway.

Table 3.16
Current and Projected Commercial Passenger Enplanements

Airport Name	2000 Passenger Enplanements	2005 Forecast of Enplanements	2015 Forecast of Enplanements	2025 Forecast of Enplanements
Phoenix - Sky Harbor International 1/	17,601,558	20,054,600	23,796,500	28,236,600
Phoenix - Sky Harbor International 2/	17,601,558	21,368,200	27,844,300	36,283,100
Scottsdale	4,999	16,200	52,100	118,100
Williams Gateway	0	250,000	1,200,000	3,333,000

1/ Low-growth scenario
2/ High-growth scenario
Source: Airport master plans, Leigh Fisher Associates, Phoenix Sky Harbor International Airport, Wilbur Smith Associates

By comparing these forecasts with the terminal design number of each airport (that is, the number of passengers the terminal was designed to accommodate), it was possible to establish whether or not terminal space will become a problem in the future.

The terminal building in Scottsdale was designed to accommodate 100,000 passenger enplanements. According to the forecasts, they will reach that level sometime between 2015 and 2025. The Williams Gateway terminal was designed to accommodate 250,000 passenger enplanements. The forecasts show that the airport will reach that level in 2005.

Specific design numbers were not provided for Phoenix-Sky Harbor International Airport. Using standard ratios that approximate total terminal square footage needs based on projected enplanements, by 2025 the airport is estimated to need between 4.9 million square feet of terminal space to meet the growth projected in Scenario 1 (the low growth scenario) to 6.3 million square feet based on 2025 projections under Scenario 2. It is estimated that the existing square footage for terminals 2, 3, and 4 is approximately 2.4 million square feet.

In terms of the number of gates, Phoenix-Sky Harbor International Airport currently has 99 gates, 94 of which are considered active. Based on standard ratios that determine gate needs and projected enplanements, it is estimated that by 2025, 137 gates would be needed to accommodate the enplanements projected under Scenario 1 and 167 gates would be needed to accommodate the projected enplanements under Scenario 2.

- Automobile Parking

Automobile parking is an important consideration to consider in the planning of commercial space needs at a passenger airport such as Phoenix-Sky Harbor International. Automobile parking requirements include public, employee, and rental car needs. Of these, public parking is the most significant and was examined as part of the RASP. Currently Phoenix-Sky Harbor International has approximately 16,400 public parking spaces, some of which are under construction in terminal 4 and in the east economy lot. Using standard ratios that tie the number of public parking spaces to projected enplanements, it was estimated that by 2025, approximately 22,000 public parking spaces would be needed to accommodate the demand projected under Scenario 1 and 28,500 public parking spaces would be needed under Scenario 2. According to airport personnel, plans have established a build out of approximately 25,000 parking spaces in the east economy area alone. Parking garages could be constructed in this area to accommodate this high number of parking spaces.

- Air Freight Capabilities

The use, amount, and type of air freight facilities needed at an airport can vary considerably depending on the nature of the freight being moved, the characteristics of the freight operators, the average dwell time, and other factors. The area dedicated to air freight operations and how efficiently that area is used are often a matter of land availability rather than a determination based on an actual mathematical formula. For example, the airfreight facilities at New York's John F. Kennedy International Airport are about four times larger than the facilities at Tokyo International Airport/Narita, even though the amount of air cargo shipped is similar.

In May 2000, Phoenix-Sky Harbor International had an "Air Cargo Development Plan" completed. In general, the plan recommended refurbishment of three existing buildings. At the time, the new south cargo facility had just been completed. In terms of square footage, with the addition of the new south cargo facility, the existing air cargo space and aircraft parking areas were noted to be sufficient to accommodate the projected demand for air cargo through 2015. A potential US Postal Service site was located and multi-tenant air cargo buildings were recommended in the 2004 to 2010 timeframe. Based on the RASP's forecasts for enplaned air cargo through 2025, additional cargo space will be needed in the 2015 to 2025 period to accommodate the projected increase of between 554,000 tons under the low growth scenario (Scenario 1) to 1.3 million tons in the high growth scenario (Scenario 2). The true need for dedicated facilities will depend on the split of the cargo carried by integrated freight carriers versus belly cargo of commercial carriers.

Williams Gateway currently uses its existing ramp for air cargo activity. The airport has no dedicated apron, nor buildings to support air cargo operations. A dedicated apron is currently under construction to support two parked Boeing 747s for air cargo activity. The airport has plans to expand this area to support up to five Boeing 747s and to construct a building to support the apron activities. The RASP forecasts for air cargo activity at Williams Gateway shows enplaned cargo increasing from 786 tons in 2000 to 14,681 tons in 2025.

ACCESS TO AIRPORTS

Accessibility of the airports by automobile is also an important aspect of addressing the ability of the region to support aviation demand. Accessibility, in conjunction with location, is one of the most important aspects in the success of an airport. For the MAG RASP, intersections near airports were examined in terms of their level of service to evaluate accessibility.

Peak-hour traffic conditions are typically measured by "level of service" (LOS). These measurements have been broken down into a scale from A to F, where A is considered the best and F is the worst. According to MAG, the distinctions for each level are as follows: LOS A through C are viewed to be operating "under capacity," LOS D is operating "near capacity," LOS E is operating "at capacity," and LOS F is operating "over capacity." LOS E and F are indicative of traffic congestion and delay that are generally unacceptable to drivers in metropolitan areas. **Table 3.17** depicts the LOS for 2001 and those projected for 2025 for the airports in the MAG region for which data were available.

Table 3.17
Regional Airport Accessibility

Airport	Intersections	2000 Level of Service	2025 Forecasted Level of Service
Buckeye Municipal	Buckeye and Sun Valley Parkway	--	C
Chandler Municipal	Cooper and Queen Creek	--	B
	McQueen and Queen Creek	--	D
	SanTan at Cooper	--	D
	SanTan at McQueen	B	E-F
Estrella Sailport	--	--	--
Gila Bend Municipal	--	--	--
Glendale Municipal	101 at Glendale	D	E-F
	107th and Glendale	B	D
Memorial	SanTan and Price Road	E-F	E-F
Mesa Falcon Field	Greenfield and McKellips	C	C
	Higley and McKellips	B	C
Phoenix - Deer Valley	7th Street and Deer Valley	B	E-F
	7th Avenue and Deer Valley	--	D
	19th Avenue and Deer Valley	C	E-F
Phoenix - Goodyear	Litchfield and Buckeye	B	D
Phoenix - Sky Harbor	North 44th Street	E-F	E-F
	East Buckeye Road	B	E-F
	South 24th Street	D	E-F
Pleasant Valley	West Carefree Highway	--	B
Scottsdale	Scottsdale and Thunderbird	E-F	E-F
Sky Ranch Carefree	Cave Creek and Pima	--	--
Stellar Airpark	Williams Field and Price	E-F	E-F
Wickenburg Municipal	--	--	--
Williams Gateway	Power and Williams Field	--	D
	SanTan at Power	C	D

Source: Maricopa Association of Governments

MAG's transportation modeling section prepared maps for 2001 and 2025 depicting LOS for intersections throughout the Region. It is important to note that 2001 data were not available for the following airports:

- Buckeye Municipal
- Estrella
- Gila Bend Municipal
- Pleasant Valley

- Sky Ranch Carefree
- Wickenburg Municipal

For 2025, data were available for two of these six leaving the following with no data on level of service at nearby intersections:

- Estrella
- Gila Bend Municipal
- Sky Ranch Carefree
- Wickenburg Municipal

According to the map prepared for 2001, the levels of service for the system indicate that six airports have at least one LOS B intersection, three airports have LOS C intersections, two airports have LOS D intersections, and four airports have LOS E-F intersections. The 2025 forecasted levels of service anticipate that only two airports will have a LOS B intersection, three airports will have LOS C intersections, five airports will have LOS D intersections, and seven airports will have LOS E-F intersections. This indicates that, systemwide, the levels of service for the intersections at the airports are anticipated to decrease by 2025, indicating a significant accessibility issue for many of the Region's airports in the long term.

For 2001, airports with LOS B intersections include Chandler Municipal (SanTan at McQueen), Glendale Municipal (107th and Glendale), Mesa Falcon Field (Higley and McKellips), Phoenix - Deer Valley (7th Street and Deer Valley), Phoenix - Goodyear (Litchfield and Buckeye), and Phoenix - Sky Harbor (East Buckeye Road). By 2025, all of these LOS ratings are anticipated to drop to LOS D, E, or F except for Mesa Falcon Field, which is expected to drop to a C.

Airports with LOS C intersections for 2000 include Mesa Falcon Field (Greenfield and McKellips), Phoenix - Deer Valley (19th Avenue and Deer Valley), and Williams Gateway (SanTan at Power). While Mesa Falcon Field's LOS C intersection is expected to remain at LOS C by 2025, both of the others are anticipated to drop to LOS D, E, or F.

Airports with LOS D, E, or F intersections for 2000 include Glendale Municipal (101 at Glendale), Memorial (SanTan and Price Road), Phoenix - Sky Harbor (North 44th Street, as well as South 24th Street), Scottsdale (Scottsdale and Thunderbird), and Stellar Airpark (Williams Field and Price). Each of these is anticipated to have 2025 ratings of LOS E-F.

On an airport-specific level, the majority of airports in the system are anticipated to have most (if not all) of their intersections with ratings of LOS D, E, or F by 2025. The only exceptions to this are Buckeye, Mesa Falcon Field, and Pleasant Valley, which have intersections that are expected to maintain levels of service at B or C.

AIRSPACE CAPACITY

Airspace, in terms of both quantity and quality, is a limited commodity and major concern in the MAG region and adjacent areas where relevant airspace restrictions are in place. Restricted airspace affects future development of airports in all categories in the region; without adequate airspace key airports cannot develop to their full potential. Improvements to ground facilities, access, environmental quality, etc. will not be effective or beneficial if the airport cannot function due to inadequate airspace or conflicts with other facilities. Poor planning can result in serious operational compromises that can have the effect of reducing capability and capacity at several airports simultaneously.

This section is organized to include the following discussion topics as they relate to airspace capacity in the Region:

- Northwest 2000 Plan
- Satellite Airport Impact
- Luke Air Force Base
- Airspace Capacity by Time of Day
- Potential Airspace Constraints on Airport Alternatives

This section is intended to describe general airspace limitations in the MAG Region as they currently exist. These limitations may impact the future development of system airports in the region. The Inventory Chapter of the RASP identified airspace features including controlled and uncontrolled airspace. In addition, MAG airspace classifications for each airport were identified, including affected altitudes. The Phoenix terminal area airspace management responsibilities associated with both the Phoenix Terminal Radar Approach Control (TRACON) and Luke Air Force Base Radar Approach Control (RAPCON) were also described. From this inventory, general observations were made concerning the limitations imposed by the airspace structure, topography, and weather patterns experienced in the Region. These observations will be added to the more specific findings associated with the Federal Aviation Administration's (FAA's) *Northwest 2000 Plan Environmental Assessment* (December, 2001) when evaluating potential RASP alternatives.

Northwest 2000 Plan

The FAA's Northwest 2000 Plan contains proposals for various flight procedural changes within the Albuquerque Air Route Traffic Control Center (ARTCC) and the Phoenix TRACON in order to increase safety, efficiency, and capacity. The need for the plan was based on the fact that greater and greater delays were being experienced in the region due to airspace limitations. The plan was adopted in December 2001, and was scheduled for implementation on February 21, 2002. It is anticipated that many of the former constraints will be alleviated by new procedures and airspace structure changes when the Plan goes into effect. This section provides a brief overview of the airspace limitations that led to the development of the Northwest 2000 Plan. Armed with this understanding, future aviation system planning in the Region can avoid exacerbating airspace limitations.

The Northwest 2000 Plan discusses limitations and potential airspace conflicts that arose from previously existing air traffic control procedures and Special Use Airspace within the Albuquerque ARTCC. The Plan was needed because the Albuquerque ARTCC airspace was designed over 30 years ago and has not undergone fundamental changes even though aircraft types, flight performance characteristics, navigational capabilities, and traffic volumes have changed dramatically. Until development of the plan, the airspace structure in the Phoenix area did not permit or support the optimum use of new technology and aircraft performance. Although there are a total of 16 public-use airports in the MAG system, Sky Harbor International is the "driver" of airspace capacity, since it experiences over 550,000 annual aircraft operations - mostly airline. Second highest in the Region is Deer Valley (370,800 operations), followed by Chandler (249,800), Mesa Falcon Field (274,665), and Scottsdale (215,585). Luke Air Force Base is also a major user of airspace in the Region with over 194,000 operations at the Base and an additional 79,700 operations handled by the RAPCON in FY 2000.

The focus of the Northwest 2000 Plan was the alleviation of route conflicts and other inefficiencies within the Albuquerque ARTCC, Northwest Specialty airspace, and Phoenix TRACON airspace. These conflicts and inefficiencies became more pronounced as traffic volume at Sky Harbor International increased. Consequently, the Northwest Specialty airspace, which controlled about 20 percent of the Albuquerque ARTCC traffic, incurred 42 percent of the total operational errors in the ARTCC during

1999. (An operational error occurs whenever standard separation is not maintained between any two aircraft). If the airspace had not been re-aligned and de-conflicted, increases in air traffic would have increased the potential for operational errors. **Exhibit 3-1** presents a graphic display of the Albuquerque ARTCC boundaries, including Northwest Specialty Sectors 38, 39, 43, and 45. Also shown are the outlines for Phoenix TRACON and Luke RAPCON boundaries. Briefly, the problems identified in each of these sectors included the following:

> ***Sector 38:*** Air traffic volume on all departure routes in this Sector had increased to the point where air traffic controllers increased in-trail separation. This, in turn, increased departure delays at Sky Harbor International. The route geometry in Sector 38 was too complex to allow traffic to flow with minimum separation.

> ***Sector 39:*** Air traffic destined for Sky Harbor International (using the FOSSL arrival path) and satellite airports (using the FERER arrival path) are controlled within Sector 39. The route geometry of both Standard Terminal Arrival (STAR) procedures required turboprops and turbojets on the FERER STAR to be sequenced below turbojets using the FOSSL STAR because the procedures crossed each other. Aircraft are instructed to fly level at these intersections to ensure separation. These level flight segments were causing delays and increased fuel consumption for aircraft. Other problems in this sector included a lack of adequate holding pattern airspace and conflicts with another Sky Harbor International departure path.

> ***Sector 43:*** Increased air traffic within this sector required air traffic controllers to increase the separation between aircraft to provide more time for proper coordination. A holding pattern in this sector, when in use, adversely impacts the Luke AFB airspace by reducing the amount of airspace it has available for aircraft training. Another conflict in this sector occurs when aircraft departing Luke AFB to the north cross one of the Sky Harbor International arrival routes. As a result, the Luke AFB traffic must remain at or below 10,000 feet (MSL), thereby increasing the air traffic complexity and adversely impacting the mission at Luke AFB.

> ***Sector 45:*** This sector controls the military aircraft in-flight refueling airspace to the northeast of Phoenix. There were no airspace conflicts due to the fact that only five percent of the Northwest Specialty airspace traffic was handled in Sector 45. Underutilization of this sector has resulted in overloading and increased complexity in other airspace sectors.

In addition to the Northwest Specialty Sectors, conflict points existed in the Phoenix TRACON airspace (Sky Harbor International TRACON boundaries are shown in **Exhibit 3-2**). Arrival and departure paths for certain west flow and east flow conditions at Sky Harbor International conflicted at crossing points, requiring increased altitude separations. The volume of aircraft operations at these crossings caused controllers to increase the spacing between successive aircraft in order to provide sufficient time for all the coordination to take place. This has resulted in some airborne and ground delays to enroute aircraft arriving to and departing from airports in the Phoenix metropolitan area.

Finally, Special Use Airspace (SUA) has created capacity limitations in the Phoenix metropolitan area. The SUA includes Military Processing Areas (MPA) and Restricted Areas within which the military conducts training and other activities to complete their national defense mission. The existence of the SUA has the effect of funneling aircraft through relatively narrow routes to and from the Phoenix TRACON. Restricted Areas and Military Operations Areas on all sides of Sky Harbor International impact approach, departure, and enroute airway development and operations. More discussion of SUA is included in the subsequent Luke Air Force Base section.

Satellite Airport Impact

Of the 17 airports considered in the MAG RASP, including Luke AFB, nine have Air Traffic Control Towers (ATCT). For enroute travel, civil aircraft desiring to access the controlled airspace above 18,000 feet must interact with both the Phoenix TRACON and then the Albuquerque ARTCC. General aviation aircraft arriving in the area via one of the designated STARs would also interact with the ARTCC, TRACON, and finally the airport-specific ATCT for landing. The Northwest 2000 Plan for satellite airport procedures is presented in **Exhibit 3-3**. As shown, general aviation aircraft coming into or departing from the Phoenix area using Instrument Flight Rules (IFR) flight plans must be integrated into the flow of other commercial and military traffic.

Discussions with the FAA indicate that there are satellite airport airspace development teams working on improvements to the airspace structure and capacity. For example, Scottsdale and Deer Valley are located in a non-radar "hole" where the Sky Harbor International TRACON must treat the two airports as one for IFR flight plans or access to upper enroute altitudes. Because these airports must operate on a "one-in, one-out" basis, there is more aircraft holding and thus, more delays than would be the case if both airports were under positive radar coverage control. To improve this situation, radar coverage would have to be expanded and ATC procedures would have to be re-defined in order for the two airports to operate independently. Other capacity impacts occur when IFR approaches to satellite airports are not canceled in flight after the pilot has the airport in view. In these cases, portions of Visual Flight Rules (VFR) airspace around these airports must be reserved for potential missed approaches, thereby constraining demand.

It can be stated that the high volume and ever-increasing number of aircraft operations at satellite airports in the Phoenix metro area result in some system delays, as backups occur within some of the ARTCC sectors. However, roughly 70 percent of the aircraft flying within the Sky Harbor International TRACON boundaries do not speak with the TRACON. Most are flying VFR and avoiding Class B and Class D airspace by flying under Class B floor levels or around Class D areas. In addition to the commercial traffic flowing through the Phoenix valley, the complexity of airspace control and use for satellite airports is impacted by the following significant factors:

- Heavy flight school training activity at airports such as Deer Valley, Chandler, Scottsdale, Mesa-Falcon Field, etc.
- Priority medical air evacuations/hospital helicopter operations
- Police/FBI aerial surveillance
- Aerial photography and mapping
- Air cargo and bank check clearing flight activity at satellite airports
- Recreational and personal flying during fair weather periods

The nature of the airspace system at satellite airports is somewhat deceptive in that a corporate aircraft may be delayed on the ground from getting into the enroute stream of traffic flowing east or west out of the Phoenix area. This delay can occur even though there are blue skies overhead and no aircraft in sight. Nonetheless, the high volume of traffic handled by the Albuquerque ARTCC and the Sky Harbor International TRACON has created some delays due to congestion on popular flight paths, the shape and direction of flight paths resulting from community concerns about overflights, satellite airport use of IFR airspace, regional topography which penetrates lower altitudes in some places, and the desire to separate aircraft with sufficient space to maintain absolute safety levels.

Luke Air Force Base

Luke Air Force Base is a significant user of SUA, military operations areas (MOAs), Military Training Routes (MTRs) and Restricted and Alert Area airspace in the Phoenix and larger regional area. Because the mission at Luke is primarily military F-16 jet aircraft training activity, any degradation of airspace infrastructure or capacity directly impacts the military mission. It should be noted that Luke AFB is home to the largest fighter wing in the U.S. Air Force (220 jets) and it is the only active-duty F-16 training wing. The current SUA will support the Joint Strike Fighter and other future military missions. Thus, it is imperative that solutions to increased general aviation and military aviation activity be found that are acceptable to all parties. As shown on **Exhibit 3-4**, military SUA is located on all sides of the Phoenix metropolitan area. While there is a large amount of military SUA in Arizona, it is released to the FAA during times that military training is not in progress. The majority of military training is conducted from Monday to Friday during daylight hours. There are plans to increase night and weekend activity at Luke Air Force Base as much as 30 percent.

Of great concern to the military is the preservation of these military airspace-training areas. For a number of years, military airspace planners were reassured that the SUA west of Phoenix would be preserved through their interaction with west valley communities and airports. With rising civil aviation activity levels into Sky Harbor International, discussions have shifted to the potential altering of SUAs north and east of Sky Harbor International. Some of these issues were examined in the *Northwest 2000 Plan*. The military is highly concerned that alteration of these SUAs will impact the mission of Luke AFB. For example, one option considered and adopted in the *Northwest 2000 Plan* was the relocation of an existing military aircraft-refueling anchor (AR-658) to the east by 30 miles. This move increased travel time for Luke AFB aircraft, reduced training time, and increased fuel expenditures and use. Such a recommendation was opposed by the military yet still appeared in the preferred alternative and was adopted in the *Northwest 2000 Plan.* By way of balance, it should be noted that the relocation of the military aircraft-refueling anchor (AR-658) would permit a significant improvement in civil air traffic management due to the current underutilization within Sector 45. This reconfiguration would serve to reduce congestion and delays now experienced in adjacent Sectors due to crossing routes.

Another preservation issue for airspace use with Luke AFB involves the location and use of live ordnance flights. In the past, both north and south departure routings were used. However in recent years, urban sprawl has consumed large portions of land north of Luke AFB. Even the remote chance of mishap has caused the redirection of all live ordnance flights to depart over the agricultural and open space to the south. Preservation of this southern departure corridor depends in part on the restriction of residential development under these departure tracks. Two legislative bills have been introduced to protect land around U.S. military bases from urban sprawl and non-compatible development encroachment. State Senate Bill 1525 would require political subdivisions and developers to consider military operations so that safe, responsible planning can occur around Arizona's military bases. State Senate Bill 1120 would start funding for agricultural preservation districts around military airports. Both of these bills recognize the disappearance of vacant buffer around military airports and the problems caused by incompatible land development around these bases.

Bad weather is the primary factor that has the potential to impact existing military airspace capacity. Airspace capacity limitations associated with military SUAs come into play when IFR weather conditions force commercial air traffic entering and departing Sky Harbor International to the northwest to push further to the southwest potentially impinging on the BAGDAD and/or GLADDEN MOA. In order to expand capacity, given the location of the existing MOAs, positive control of airspace within the MOAs would be required. Thus, instead of capping MOAs and handing off large blocks of airspace for civilian use during bad weather, positive control would permit military controllers to separate their military aircraft from the civilian traffic on a real-time basis.

According to Luke AFB personnel, several other recent proposals would negatively impact Luke AFB's IFR airspace capacity. These include:

> ***Dual ILS Airspace proposal for Sky Harbor International:*** This proposal would have the effect of extending Sky Harbor International Class B airspace ceilings from 5,500 MSL to 8,000 MSL in Luke AFB terminal airspace area. Direct impacts of the proposed change include the loss of Luke AFB simulated flameout pattern; all IFR approaches would have to be Radar Required; and it would increase workload on controllers and pilots to maintain separations.

> ***Deer Valley GPS Runway 7R proposal:*** This proposal would require coordination of new ATC procedures involving Luke AFB, the Sky Harbor International TRACON, and Deer Valley ATCT. The impact to Luke is greater workload for the Luke RAPCON.

> ***Expansion of Sky Harbor International Terminal Airspace to the North:*** Impacts or limits northern Military Training Routes.

> ***Utility Towers, New RV Parks, Small Airport Request in Tonopah:*** All of these developments have the effect of limiting Military Training Route activity either by increasing the minimum altitude available or eliminating the route entirely.

> ***Low Altitude Night Tactical Infrared Navigation Check Pattern:*** Moved in 1995 to west of the White Tanks Mountains by land development, is now threatened again by development under the pattern.

All of these developments and new proposals have the effect of changing the current airspace configurations thereby possibly limiting the mission at Luke or increasing the workload for Luke RAPCON personnel. One issue - the dual ILS proposal at PHX - is mitigated by the fact that it would only be invoked during appropriate Instrument Meteorological Conditions (IMC) in the Phoenix area. This occurrence is rare, and may have an impact of perhaps 4 days per year. Discussions with Luke AFB representatives indicated that the current airspace configuration in the Phoenix area is adequate to accommodate all of their existing mission needs. However, changes to these configurations brought about by any of the above proposals or conditions were anticipated to adversely impact the mission of Luke AFB.

For the future, military airspace planners believe that when the Joint Strike Fighter is introduced to the U.S. Armed Forces, the existing SUAs in the Phoenix area will be able to accommodate basic training with the aircraft. Because of the supersonic capability of the new aircraft, there are no SUAs over land that will be able to accommodate all of the capabilities associated with the new fighter jet. Presently, Luke AFB is not programmed to receive the Joint Strike Fighter but it is possible that this may change in the future.

Airspace Capacity by Time of Day

From an airspace capacity standpoint, the fewer aircraft operations in an area, the greater the available capacity. Conversely, during peak periods, the airspace system is potentially strained to accommodate all the traffic. In this regard, discussions with FAA indicated that there are two primary peak demand periods at most Phoenix area airports during the day: morning (6:00 a.m. to 8:30 a.m.) and afternoon/evening (5:00 p.m. to 7:30 p.m.). A third peak occurs during mid-day (11:00 a.m. to 1:30 p.m.). As traffic volumes increase in the Sky Harbor International area, peak periods of demand tend to spread out. As late evening approaches, the number of aircraft operations diminishes, adding to the available capacity of the airspace system. The *Northwest 2000 Plan* Environmental Assessment shows average day and night time operations for Sky Harbor International. The data shows an overall split of 91.0 percent/9.0 percent day/night operations. (Nighttime is defined as 10:00 p.m. to 6:59 a.m.). Segregating the general aviation portion of demand, the split is 94.9 percent/5.1 percent day/night operations. Discussions with FAA indicated that the 5 percent night operations by general aviation are representative of general aviation traffic in the Sky Harbor International region. Thus, over a 24-hour period, potential airspace capacity constraints for enroute aircraft are limited to several peak period times during daylight hours.

Potential Airspace Constraints on Airport Alternatives

The FAA has maintained that airspace constraints will not limit the development of a general aviation system in the Sky Harbor International area. While enroute capacity may be constrained by volumes of air traffic entering and departing the region, the Phoenix valley itself will not experience VFR airspace capacity limits for the development of new general aviation airports. Instead, limitations concerning the number of runways that can be developed, the number of aircraft that can be housed, and the annual service volume of the runway system will limit operational capacity long before the airspace system denies aircraft access. If new general aviation airports are to be developed, finding suitable land and environmental approvals will be far more difficult than finding available airspace. For the air carrier system, a 4th runway at Sky Harbor or the development of commercial air service at Williams may require new procedures that would impact other airports or IFR airspace capacity constraints as they currently exist. However, each proposal must be examined separately before any conclusions regarding airspace capacity limitations can be drawn. In the evaluation of alternatives, each alternative airport development proposal will be examined with regard to its impact on airspace capacity and compatibility.